

BOOK REVIEWS

ROCK GLACIERS by D. Barsch, Springer Series in Physical Environment 16, Springer, Berlin, 1996. No. of pages: xiv+331. Price: DM228 (c. £91). ISBN 3-540-60742-0.

This book is a summary of some 90 years of investigations into rockglaciers throughout the world; Dietrich Barsch has been involved for the last thirty. It is testimony to one person's view of these singular features (who refers to them using a single word). There is much here that is new or only recently published in German, with data extracted from rather obscure sources. For this alone, the author should be thanked. It becomes clear from the text that, for Barsch, there is one explanation for the existence of rockglaciers: the existence of permafrost in a suitable, weathered rock mass. Specifically, rockglaciers are a product of ice accumulation by permafrost processes in mountains, and correspond to a climatic regime of mean annual temperature ($<1.5^{\circ}\text{C}$). Thus fossil rockglaciers indicate past permafrost conditions.

The whole thesis is a presentation of evidence for the existence of rockglaciers as permafrost-derived features. This is quite successful, but the case takes some time to develop. Two short chapters deal with 'Definitions' and 'The historical development of the term rockglacier'. You may wonder why the latter is necessary, but with four possible terms in English to consider as well as German terms which are not equivalent, reading the literature can be confusing. A much better idea of the nature of the features than the definitions provided in Chapter 1 or Chapter 3 (Descriptions and morphometry) is provided by photographs, but it is unfortunate that, on p. 189, the first example (Figure 1.1) is discussed under the heading of 'problematic cases'. Nomenclature problems have made it difficult to comprehend all the nuances of the subject, as well as 'who said what and when', let alone 'what did they mean?'. The subject area is littered with changed views and opinions over the years. Unfortunately, *Rockglaciers* will not help untangle all the knots. This is hardly surprising when such a range of both fossil and extant features is to be found. A separate chapter (4) on taxonomy is only marginally enlightening, Barsch presenting a complex summary scheme from a previous paper. Chapter 5 is concerned with rockglacier distribution; by whatever name, they were discovered independently in many parts of the world. The chapter gives a good basis for an overview of their occurrence and is very useful as a compendium of maps and diagrams from diverse sources. The dependence on high mountains and certain temperature/precipitation factors, such as mean annual air temperature and regional snowline, is evident.

Chapter 6, 'Rockglacier material, surficial fabric and internal structure' is a long chapter, some 57 pages, presenting and evaluating the evidence for rockglaciers as

'two-layered phenomena'. About the outer there is little dispute and, for the most part, little interest. The inner, 'rockglacier core' is an altogether different matter and the bulk of the chapter is devoted to the data. Barsch realized early in his studies of rockglaciers that geophysical methods were necessary to examine the almost impenetrable innards of rock glaciers. Seismic and georesistivity measurements provide the bulk of these data in Chapter 6, plus gravimetry and thermal measurements. Surprisingly, resistivity data obtained from the Marinet rockglacier in France by Fabre and Evin are not included here. It is not possible to discuss the general findings here; suffice to say that there are considerable problems of interpretation. The mixture models used as 'standards' are themselves the unknowns we are trying to find. The reader should be aware of these difficulties.

Movement, velocity and rheology of rockglaciers are dealt with in Chapter 7. One of the most intriguing things about rockglaciers is their slow flow (generally rather less than 1 m a^{-1}). Much of the data in the book come from the Alps, a little from Colorado and Alaska, but the high velocities ($>5\text{ m a}^{-1}$) of some Altai rockglaciers are passed over, as are results and analyses from some long-standing observations in Iceland and the USA. The anomalous and perhaps critical, sliding behaviour of Gruben rockglacier is mentioned in Chapter 7 (under 'seasonal movements') but the 'unanswered question' is hardly mentioned in the later section (7.5) and a further reference to Chapter 8 reveals nothing new. We come to the heart of the rockglacier problem in Chapter 8, dealing with rockglacier genesis. Some would say that it is not a problem; 'the rockglacier question' has been solved. A single viewpoint is upheld with little on the alternative (glacier core) model. However, this may be the chapter that many wanting to know about rockglaciers should read first.

In Chapter 9, lichenologists will be interested that the author believes the technique must be restricted to surface ages less than 300 years. However, Barsch does not envisage rockglaciers being the product of Little Ice Age activity, as has been suggested by several authors. There are many more data on rockglacier ages available than given here; in particular, the work of Benedict. This rather sparse chapter could be more wide-ranging in its coverage. Chapter 10 deals with rockglaciers and high mountain permafrost and stresses the importance of identification. It contains an interesting, if brief, discussion about the role of rockglaciers in the 'coarse debris cycle' which includes corrie backwall/cliff retreat and leads on to their role in debris transport systems. The ideas here are, of course, predicated on the permafrost model. Finally, Chapter 11 provides a 'Summary and outstanding problems', of only two and a half pages; this indicates some of the latter, but does not do justice to the preceding text.

This book appears to present 'all you want to know about

rockglaciers', but from a rather singular perspective. Some data are not presented, but there are always problems of what to include for any author. A more serious point relates to the omission of discussion. Any alternative views to the permafrost model are treated with disdain rather than dispassionate critique. There are many references to 'wrong views' and 'wrong interpretations'. Such selectiveness detracts from the utility of the book and the one-sidedness is unscientific at best and censorship at worst. This review cannot provide the detailed arguments needed for readers to be able to judge the book's scientific integrity. However, there is no reason to conclude that the volume should be

disregarded. It will repay close study, but those neutral in the conflict need to be forewarned. Despite being selective, *Rockglaciers* brings together a wide variety of information and contains a good, although by no means complete, bibliography. Finally, in these days of finely tuned library budgets, value for money is an issue. The paper and printing quality are good but proof-reading leaves something to be desired. Unfortunately, the book is just far too expensive unless there is a really pressing need for its acquisition.

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RECONSTRUCTING QUATERNARY ENVIRONMENTS (2nd edition) by J. J. Lowe and M. J. C. Walker, Addison Wesley Longman, Harlow, 1997. No. of pages: xxii+446. ISBN 0-582-10166-2.

This book is remarkable for the sheer volume and the comprehensiveness of the information it provides. With around 370 pages of text, and a 60-page bibliography, I find it hard to believe that anyone interested in the Quaternary could not find something new and useful in this book.

After the introductory chapter, which briefly covers the character and duration of the Quaternary, the historical development of Quaternary studies, and the resulting framework for the Quaternary and possible causes of climatic change, the main body of the book divides into three parts. In Chapters 2 to 4, the geomorphological, lithological and biological evidence that forms the basis for environmental reconstruction is outlined. Chapter 2 includes discussions of glacial and periglacial landforms, sea-level changes, river terraces and landforms at low latitudes. Chapter 3 examines glacial and periglacial sediments, palaeosols, low-latitude lake sediments, aeolian sediments, cave and other carbonate sediments, lake, mire and bog sediments, deep-ocean sediments and ice-core stratigraphy. Chapter 4 then covers pollen analysis, diatoms, plant macrofossils, fossil insects, non-marine and marine mollusca, ostracods, foraminifera, deep-sea sediment micropalaeontology, vertebrates, and includes shorter discussions of some other fossil groups. Within this group of chapters, each section follows broadly the same pattern; the nature of the evidence is discussed first, followed by the techniques used to analyse and interpret it; finally, the main uses of the evidence in environmental reconstructions are considered.

The second part of the book, Chapters 5 and 6, firstly reviews the various dating methods used in Quaternary science, then turns to the principles of stratigraphy and correlation used to construct spatial and temporal sequences from fragmentary evidence. Chapter 5 is similarly organized to Chapters 2–4; each method is presented in turn, and its techniques, uses and limitations are discussed. Chapter 6 deals firstly with the techniques and problems of temporal ordering (i.e. stratigraphy) of the various types of evidence discussed in the first part of the book, and then turns to the techniques and problems of spatial ordering of evidence (i.e. correlation).

The final part of the book, Chapter 7, presents a 'case study' of Quaternary environmental reconstruction, to show how the disparate lines of evidence available can be brought together to provide a coherent picture of environmental change. This chapter is new to the second edition. The case study used is the North Atlantic region over the last climatic cycle. The discussion covers the broad stratigraphic framework of the period 130 000 years before present (BP) to 10 000 years BP, then covers the main subdivisions, including the last interglacial, the interglacial/glacial transition, the last 'cold stage', and the glacial/interglacial transition, in much more detail. In particular, these sections seek to draw together the disparate lines of evidence available from oceanic, terrestrial and ice-core records for each period to provide a regional picture of the environment of the North Atlantic, and how it changed during the period in question. These reviews are generally impressively up-to-date, given publishing constraints; most sections include citations to papers published as recently as 1995, although it is a pity that the debate concerning the validity of apparent Eemian climatic oscillations in the GRIP and GISP2 ice cores is not touched upon. The chapter then turns to the uses and limitations of models, and Global Circulation Models in particular, in Quaternary studies, before reviewing the various causes for the climatic and environmental changes discussed in the previous section. These include astronomical (orbital) influences, the role of the oceans, ice-sheet fluctuations, atmospheric gas content, volcanism, solar output and geodynamic factors. The chapter concludes with a brief review of broad conceptual models which attempt to explain the climatic changes over an interglacial/glacial cycle.

To conclude, although some Quaternary specialists may, as the authors admit, argue about the detailed content of sections of the book, and the balance of detail in the various parts of the book, the overall value of this comprehensive review cannot be denied. As an undergraduate and postgraduate, I made great use of the first edition; I am sure that current students of the Quaternary at all levels, and even Quaternary researchers seeking information about fields outside their own specialization, will find this revised edition of equal value.

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